WESTERN GRAPHTEC

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ACL3101

SIGNAL CONDITIONING AMPLIFIER

OPERATION MANUAL

PREPARED M. HUSSAIN	WESTERN GRAPHTEC	SHEET 1 OF 15	
APPROVED M. Storey	12 CHRYSLER STREET	SPECIFICATION NO. 73801-001	REV A
DATE 06/13/85	IRVINE, CALIF 92718		

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I. GENERAL INFORMATION:

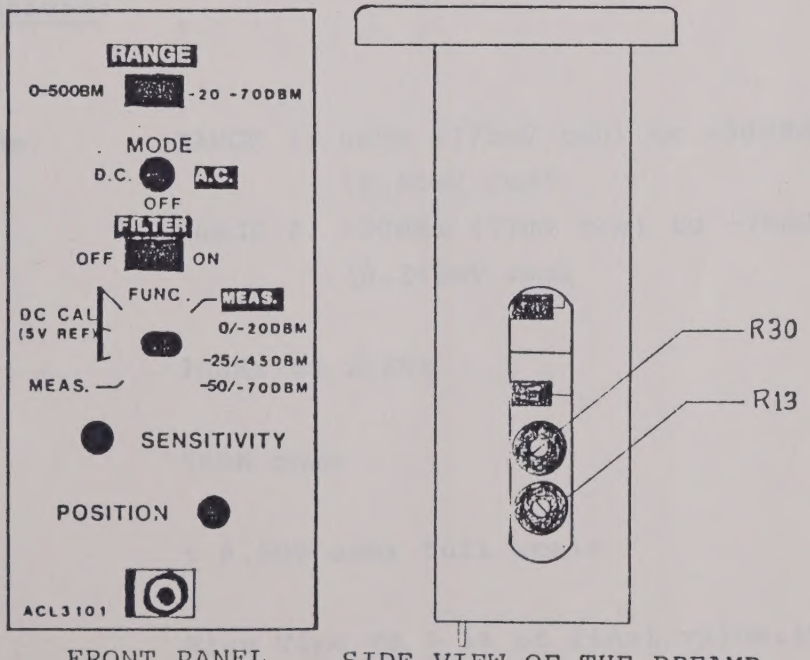
Introduction

The Signal Conditioning Amplifier ACL3101 is specially designed to operate with the Western Graphtec Linearcorder Mark-VII (WR3101). It is a plug-in module. This module is a bi-functional unit capable of conditioning DC signals, as well as, audio frequency signals. It uses a right hand zero.

Features

CONTROL	DESCRIPTION
MODE	Selects the basic mode of use, either direct DC recording or logarithmic compression.
FUNC.	In DC mode operation "FUNC." selects either the internal DC calibration reference or DC measure of input signal. In AC mode operation "FUNC." selects either of three calibration levels or AC measurement of input signal.
RANGE	This control operates only when "MODE" is in the AC position. "RANGE" selects either the 0 dBm to -50 dBm full scale range or -20dBm to -70dBm full scale range.
FILTER	This control operates only when the "MODE" is in AC position. "FILTER" ON selects operation of the filter. The filter "smooths" the trace, but passes sporadic impulses.

CONTROL	DESCRIPTION
SENSITIVITY	Operates only when the "MODE" control is in the DC position. Used in conjunction with the FUNC. DC CAL. (5V ref.) provides infinite DC full scale ranging between 5V full scale and 50V full scale.
POSITION	Operates only when the "MODE" control is in the DC position. Allows positioning of input "ZERO" anywhere within the chart range.
AC POSITION TRIM (R30)	Provides means of trimming mid-scale position to match amplifier module to servo-motor.
AC SPAN TRIM (R13)	Provides means of trimming full span excursion of servo-motor to amplifier module.



FRONT PANEL SIDE VIEW OF THE PREAMP

FIGURE I-1

PREPARED M. HUSSAIN	WESTERN GRAPHTEC	SHEET 4 OF 15
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II. SPECIFICATIONS:

Introduction

This section provides information regarding various specifications in DC mode and AC mode operations.

The DC function provides direct recording of signals from DC upto 125 Hz. A veriable sensitivity control is provided to allow chart scaling from 0.125 volts/division to 5.0 volts/division.

In AC mode, the amplifier computes the true RMS value of any complex input signal. The RMS value is then operated upon by a logarithmic to linear converter to yield a final output in dBm. The dynamic range of the AC function is 50dB.

Operational Specifications:

AC MODE

Input Signal Amplitude:	RANGE 1: 0dBm (775mV rms) to -50dBm (2.45mV rms) RANGE 2: -20dBm (77mV rms) to -70dBm (0.245mV rms)
Frequency Range:	100Hz to 20KHz
Input Impedence:	500K ohms
Non-Linearity:	± 0.5dB over full scale
Dynamic Response:	Rise Time to ± 1% of final value:10usec (Filter OFF)

AC MODE (CONT.)

Filter Characteristics:	Rise Time to ±1% of final value:0.7 sec. Corner: 1.1Hz. Roll of rate: 3dB/Octave Passes impulse information if 3dB above average logged level.
Temperature Drift:	0.1dB/°C.

DC MODE

Sensitivity:	Adjustable from 0.125V/div. to 5V/div.
Input Impedence:	1 Meg. Ohms.
Maximum Input Signal:	±250VDC.
Frequency Response:	-3dB at 125Hz.
Non-Linearity:	±0.5 divisions maximum over full scale.
Zero Drift:	0.5 Div./10°C max.

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III. OPERATION:

Introduction

The ACL3101 Signal Conditioner Amplifier is a dual function module, capable of conditionong direct current and audio frequency inputs. This amplifier provides telecommunications industry with a means of monitoring the wide dynamic range of signals, common to that industry.

Theory of Operation

DC FUNCTION- The input stage to the DC amplifier is single-ended, being comprised of a 1 meg ohm resistor and a 25K ohm pot to form a a 1/41 divider. The wiper of the 25K pot is the sensitivity control, further dividing the input signal over the range of 1/41 to 1/∝. Divided input signal is then directly passed to a DC amplifier having a fixed gain of 45. Pen position control is provided by supplying offset voltage to the DC amplifier's inverting input.

AC FUNCTION- Input signals are AC coupled to the input network. The input work has two switch selectable attenuation settings, both of which are balanced and referenced to the floating ground. The input ratios are 0.053 and 0.53, corresponding to input ranges of 0 to -50dBm and -20 to -70dBm respectively. The RMS values of those input ranges are 775mV to 2.45mV and 77.5mV to 0.245mV respectively. The divided signal is passed directly to a true differential amplifier with a fixed gain of 100. Note that the product of the respective input ranges, attenuator ratios, and differential stage gain, produce the same stage output span. The output of the differential stage is then capacitively coupled to the conversion stage. This prevents any DC output offset produced by the differential stage from causing any error in conversion. The conversion stage performs two functions simultaneously, RMS level computation of incoming AC

signal, and logarithmic computation of the RMS level. RMS computation follows the equation below.

$$V_{rms}=V_{avg}\left(\frac{V_{in}^2}{V_{rms}}\right)$$

The result of this computation forms the basis for the I_{in} component in the next conversion. The logarithmic conversion equation follows.

$$20 \log \frac{I_{in}}{I_{ref}}$$

The quantity "I_{ref}" is a fixed reference current externally supplied to the converter to establish its "0 dB", or operation range midpoint. It is important to note that the log converter's 0 dB point corresponds to the midpoint of both the modules' input ranges, not to 0 dBm. Converter reference current is externally supplied by a precision 2.5 volts, temperature-compensated, integrated device. Factory calibration of the converter stage is accomplished by trimpot adjustment of the reference current. Following the converter stage is an adjustable low gain DC stage. This stage serves two purposes: first it provides a -0.3%/°C temperature co-efficient to correct the log converter's positive drift with temperature. Second, it provides the necessary amount of span adjustment to match the amplifier module to its recorder channel servo. The next stage is a special function filter; a front panel switch has been provided to allow discretionary use of the filter as the situation warrants. The purpose of the filter is to smooth the output by finding the average level of the logged signal over approximately a 0.3 second period, yet allow sporadic impulse information to "pass" if it is 3 dB or more above the average level. The essence of the filter's circuital composition is an RC low pass filter shunted by a threshold detector. The threshold level is trimpot adjusted at the factory, such that the

recorded trace difference of impulse inputs, filter ON vs. filter OFF, is ±1dB. When the filter function is "switched out", the resistive portion forming a 2 to 1 voltage divider remains in place, thus precluding any scaling errors, filter ON vs. filter OFF. The final stage in the AC function path is an output buffer. The output buffer has a non-inverting gain of two (+2). It also provides the means of centering the output span through a 1K ohm trimpot.

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IV. CALIBRATION AND OPERATION PROCEDURE:

Install the amplifier in the recorder mainframe. Turn ON the recorder power and allow five minutes for the amplifier to warm-up.

AC USER CALIBRATION - There are three factory calibrated internal DC reference levels, selectable by a front panel switch, used to verify proper operation of the module in the recorder. The three levels are 775mV DC, 43.58mV DC, and 2.45mV DC; they correspond to 0dBm, -25dBm, and -50dBm respectively. When any of these references are selected by the "FUNC." switch, the path from the differential stage to the converter input is opened. Not that because of the converter's true RMS measuring capability, and the fact that the differential stage always presents the converter with the same input range, only one set of the DC references is required. The reference levels present the end points and the exact center of the recorded span. Three known points allow the user to make minor adjustments to the module to match its span and center to the recorder channel it occupies without requiring external calibration standards.

AC OPERATION - Place the front panel controls in the following conditions:

MODE:	AC
AC FUNCTION:	-25/-45dBm (CENTERSCALE)
FILTER:	OFF
ALL OTHER CONTROLS:	N/A

[1] Select a minimal chart speed; the pen should now be tracing at chart center ±1 trace width. If this is true, proceed to step 2. If this is not the case, go to step 1A.

1A If the trace is unacceptably off-center, remove the amplifier from the machine and re-install it in the same recorder channel via an "EXTENDER BOARD". Re-apply recorder power. Adjust the single turn pot, labeled R30, until the trace is properly positioned. Go to step 2. (R30 is located at the center of the slot, top edge of the case.) (see fig. I-1).

2 Re-position the "AC FUNCTION" control to -50/-70dBm; all other controls remain the same. The trace should now rest at the bottom margin ±1 trace width. (Ref. chart flow from left to right) If this is true, proceed to step 3; if this is not true, go to step 2A.

2A Remove the amplifier from the recorder and re-install it in the same channel via an "EXTENDER BOARD". Adjust the single turn pot, labeled R13, located at the bottom of the chassis slot, until the trace is properly positioned (see fig.I-1). Now go to step 3.

3 Re-position the "AC FUNCTION" control to 0/-20dBm; all other controls remain the same. The trace should now rest at the top margin ±1 trace width. If this is true, the system is calibrated and ready for use when the "AC FUNCTION" control is moved to the MEAS. position.

4 Use of the "FILTER" is discretionary. In conditions of high noise, the filter may be employed to smooth or narrow the recorder trace. A special feature of the filter is its ability to attenuate the "AM" effect in the logged output during high noise condition, yet still pass impulses that exceed the "AM" effect by approximately 3dB. The significance of this feature is that high amplitude short duration "SPIKES" that are so

detrimental to information transmittal are not lost in the filtering process.

DC USER CALIBRATION - When the module is employed in the DC mode and the "FUNC." switch is moved to DC CAL. position, channel input is removed, and connection to internal equivalent 5V reference is made. The actual value of the DC reference voltage is 0.122 volts. This is the same value that would be measured at the output of the 1/41 divider, given a DC input to the module of 5 volts. The internal DC reference allows the user to adjust the "SENSITIVITY" control to achieve the desired full scale span without having to use an external calibration standard.

DC OPERATION - Place the front panel controls in the following positions:

MODE:	DC
DC FUNCTION:	MEAS.
POSITION:	FULL COUNTERCLOCKWISE
SENSITIVITY:	FULL COUNTERCLOCKWISE
ALL OTHER CONTROLS:	N/A

1 Position the pen trace on the bottom margin using "POSITION" control.

2 Re-position "FUNC." switch to DC CAL.; this connects an internal 5V reference equivalent.

3 Adjust the "SENSITIVITY" control to obtain the desired sensitivity. The maximum sensitivity is 5V Full Span = 0.125V/div.

4 Re-position the "FUNC." switch to MEAS.

5 If a "0" position other than the bottom margin is required,

re-position the "0" to suit. The sensitivity will remain unaffected.

6 The system is now ready to operate with the ACL3101 Signal Conditioning Amplifier.

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V. SERVICE INFORMATION:

There are no user servicable adjustments or components within the ACL3101 Signal Conditioner Amplifier. If service or recalibration become necessary, return of the unit to the factory is recommended.

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VI. BLOCK FUNCTION DIAGRAM & SCHEMATIC:

Following documents are attached herewith for the user of the ACL3101 Signal Conditioning Amplifier:

1	Block Function Diagram -	Attachment#1
2	Schematic-ACL3101 Circuit Board-	Attachment#2

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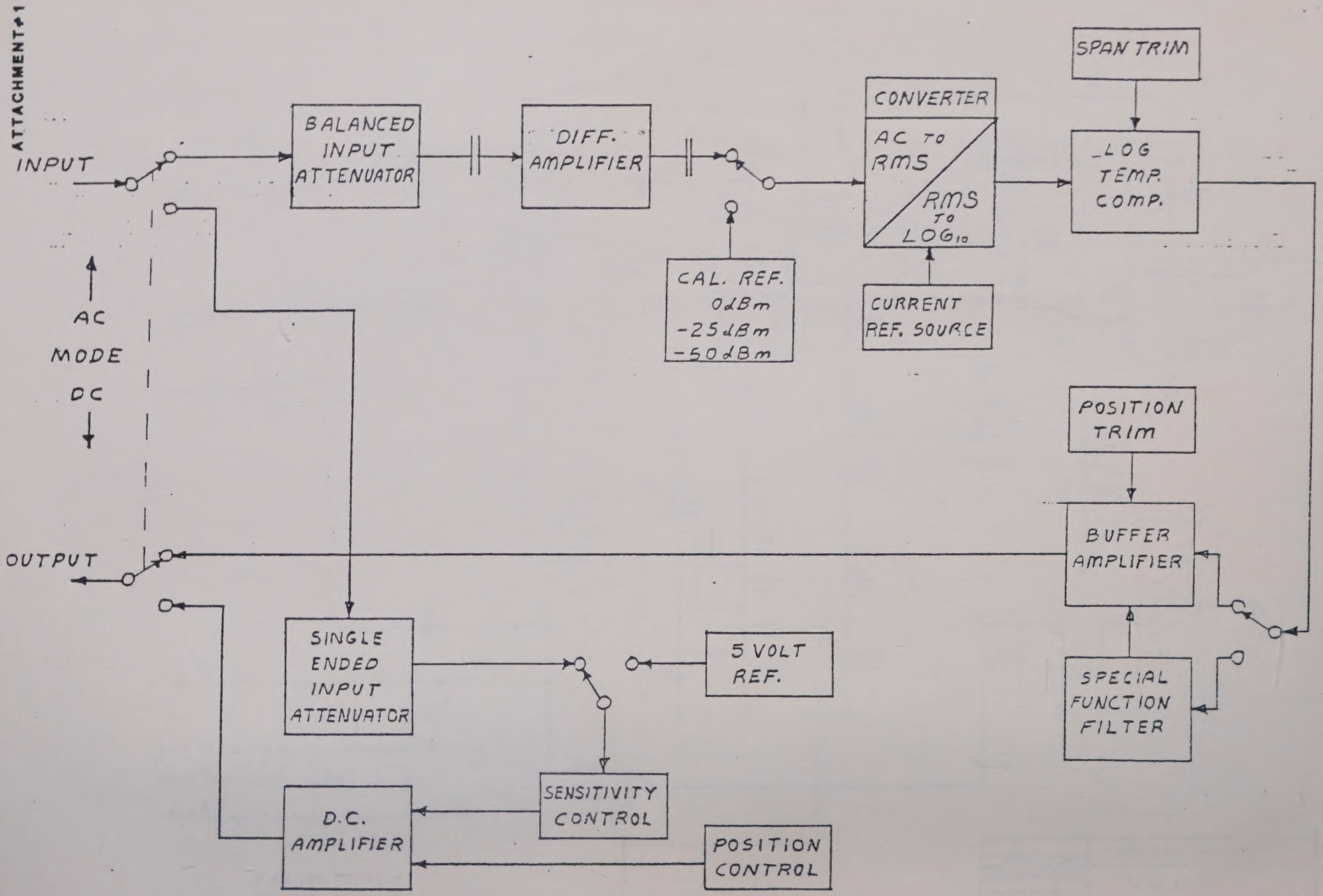
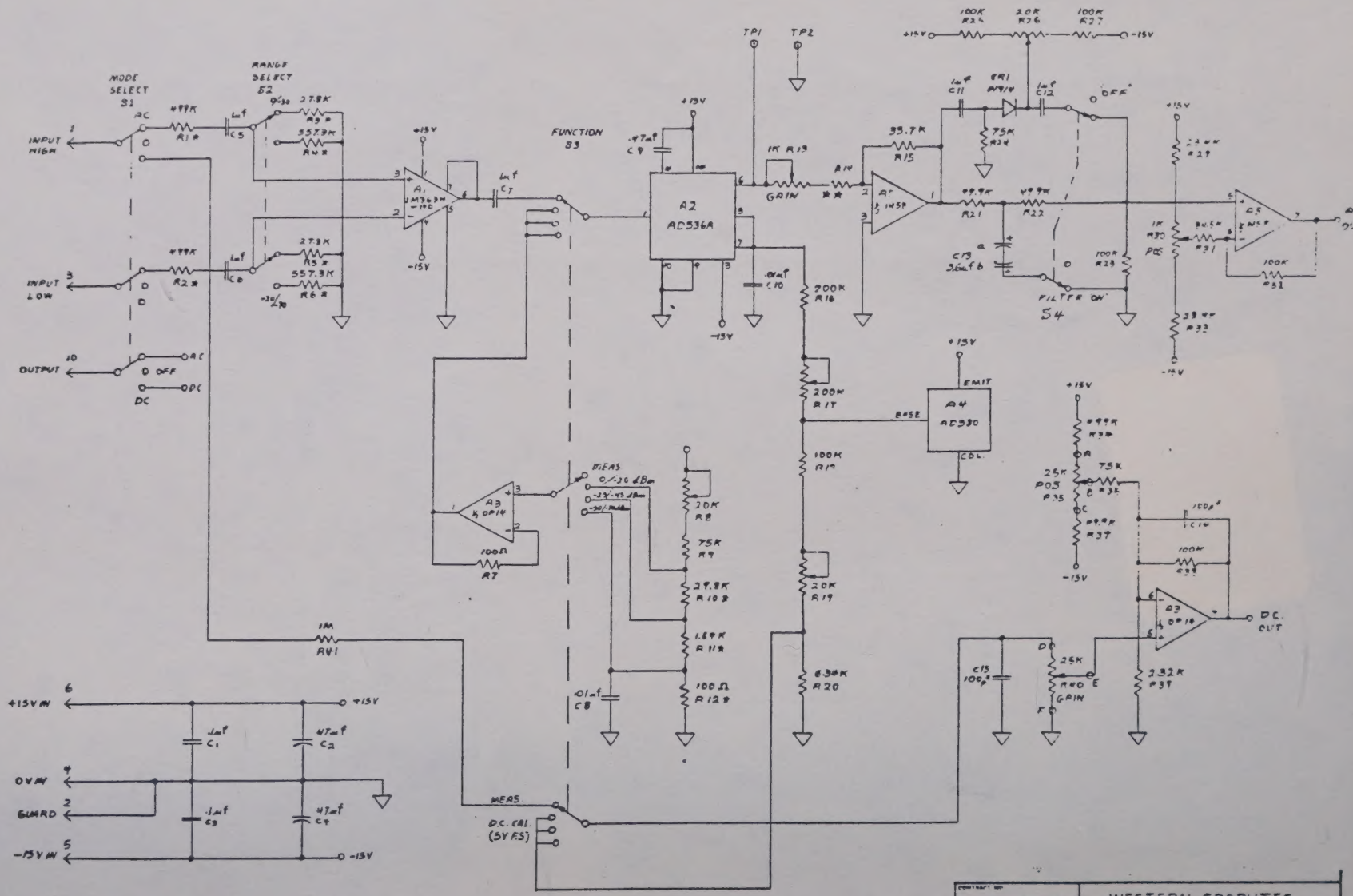
ATTACHMENT #1



ACL 3101

ATTACHMENT #2



★ .1% TOL. RESISTOR
★★ 1K 1% 3000 ppm/°C

	WESTERN GRAPHTEC	
MARK STOREY 7/1/88	SCHEMATIC	
	SIZE C	CODE IDENT NO. 10
- REV A	SCALE NONE	REV - B
		ACL3101
		SHEET 1 OF 1

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